

Pre-Lab Exercise for *Magnetic Force*

1. For this lab, what is the purpose of the filament?
2. In this lab, how are the electrons accelerated i.e. how do they acquire a velocity?
3. In this lab, how is the path of the electrons made visible?
4. In this lab, the beam of electrons is bent into a circle by a magnetic field produced by Helmholtz coils. What are Helmholtz coils? (Hint: See problem 58 on page 733 in the textbook.)
5. The goal of this problem is to obtain eq. (6) in the lab write-up.
(a) On the back of this page, work part (a) of Problem 58 on page 733 of the textbook to show that for Helmholtz coils, the magnetic field on the axis between the coils at a distance x from the center of one coil is

$$B = \frac{\mu_o INR^2}{2} \left[\frac{1}{(R^2 + x^2)^{3/2}} + \frac{1}{(2R^2 + x^2 - 2Rx)^{3/2}} \right]$$

(Hint: The result of Example 28-10 on page 720 of the textbook could be helpful.)

- (b) Since the beam is approximately halfway between the coils, $x=R/2$. Plug this value into the above equation to show that at the beam the magnetic field is

$$B = \frac{8\mu_o IN}{5\sqrt{5}R} \quad (6)$$